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2017臺灣淡水魚類紅皮書名錄

The Red Lists of Freshwater Fishes of Taiwan, 2017

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The Red Lists of
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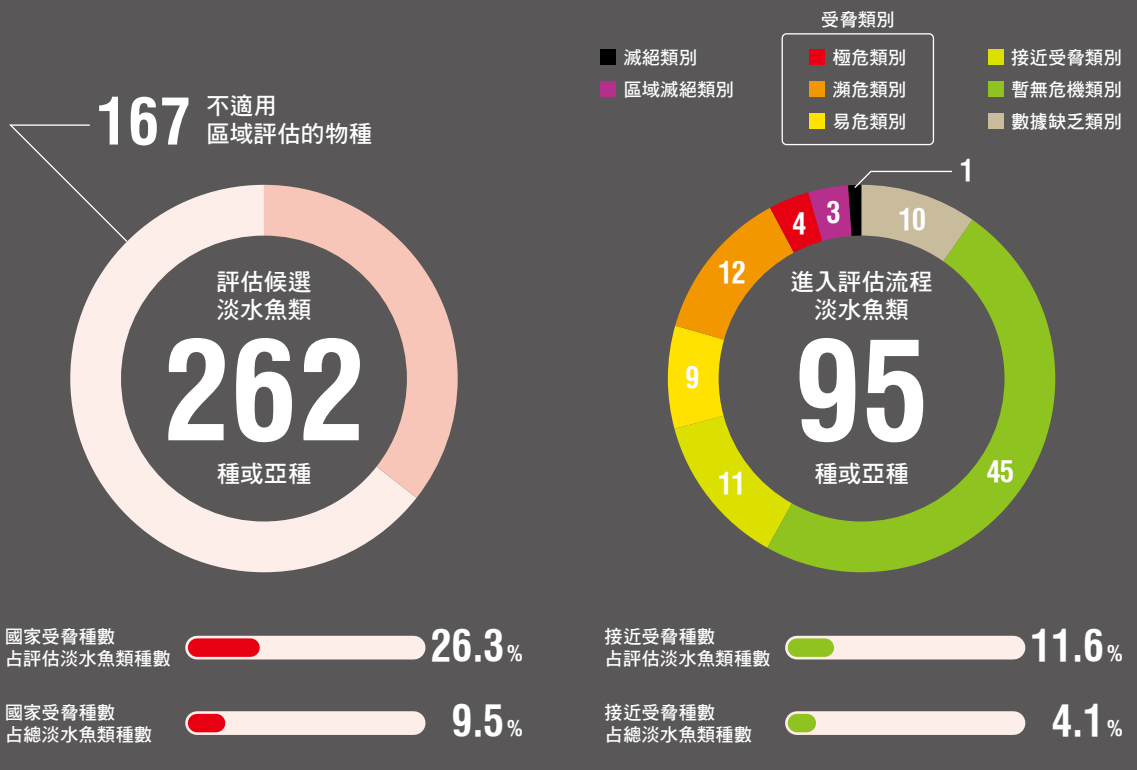
摘要

本報告為臺灣第一次依據國際自然保育聯盟 (International Union for Conservation of Nature) 紅皮書受脅與評估系統 (IUCN Red List of Threatened Species ™) 的建議類別與標準對所有原生淡水魚類進行國家淡水魚類紅皮書名錄評估。納入評估候選種類共 262 種，其中 167 種不適用 (Not Applicable) 區域評估篩選門檻，95 種進入評估流程。結果臺灣有 4 種淡水魚類已經滅絕，其中 1 種屬於滅絕 (Extinct)，3 種屬於地區性滅絕 (Regionally Extinct)。25 種或亞種國家受脅 (Nationally Threatened) 淡水魚類，其中屬國家極危 (Nationally Critical) 類別有 4 種，屬國家瀕危 (Nationally Endangered) 類別有 12 種，屬國家易危 (Nationally Vulnerable) 類別有 9 種，另有 11 種歸於國家接近受脅 (Nationally Near-threatened)。國家受脅及接近受脅淡水魚類種數分別占評估淡水魚種數的 26.3% 及 11.6%，以及總淡水及河口魚種數的 9.5% 及 4.1%。45 種列為國家暫無危機 (Nationally Least Concern)；10 種列為資料缺乏 (Data Deficient)。出現於臺灣的全球受脅及接近受脅淡水魚類共有淡水魚類共有 6 種，其中 3 種屬國家受脅，2 種屬國家接近威脅。

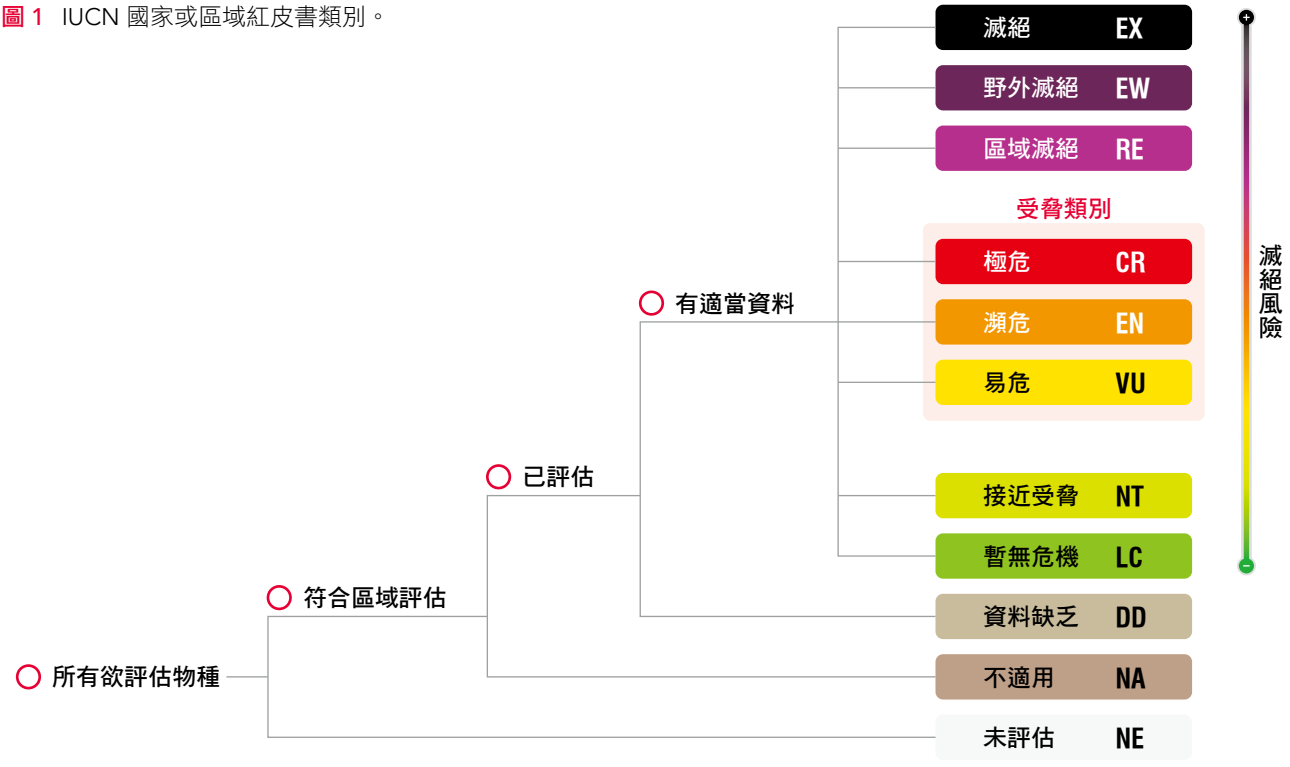


1. 前言

由國際自然保育聯盟 (International Union for Conservation of Nature, IUCN) 物種存續委員會 (Species Survival Commission) 所執行的 IUCN 紅皮書名錄 (IUCN Red List of Threatened Species) 作業流程，自 1964 年開始發布以來，已逐步成為評估全球物種保育狀況與變化趨勢的最重要參考依據 (Rodrigues *et al.* 2006；IUCN 2016)；其後續發布的 IUCN 紅皮書名錄地區及國家級評估標準應用指南，也成為許多國家評估其境內受脅物種名錄的重要遵循標準 (Townsend *et al.* 2007；IUCN 2012a)，該項評估的結果，不僅有助於了解地區及國家級的物種受脅狀況，也讓全球紅皮書所涵蓋的物種更加地完整 (Rodrigues *et al.* 2006)。

如果一個國家或地區稱其國家或區域紅皮書的產生是依據 IUCN 系統，那麼就必須無偏差地根據 IUCN 紅皮書類別及標準 (IUCN Red List Categories and Criteria) 進行評估 (IUCN 2012b)。而所謂區域 (region) 指的是地球範圍內，任何一個可明確界定的空間範圍，如大陸、國家及州省等 (IUCN 2012a)。由全球至區域時，對受脅物種評估而言，自然會產生原生或外來種，繁殖或非繁殖物種，或如先前曾經分布，但已局部滅絕的區域現象 (IUCN 2012a)。本報告採用的評估標準與類別係依據 IUCN 紅皮書

圖 1　IUCN 國家或區域紅皮書類別。



Squalidus banarescui
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名錄類別與標準 : 3.1 版 (IUCN 2012b)。然而，由於空間尺度的關係，當前述標準應用於分布不完全侷限於評估範圍的物種時，評估流程與標準設定的閥值可能並不適當，因此必須有所有調整。IUCN 紅皮書名錄地區及國家級評估標準應用指南提供調整建議 (IUCN 2012a)。

在臺灣，陳義雄等曾針對淡水魚類進行過受脅程度的分析，並且在 2012 年透過林務局正式出版「臺灣淡水魚紅皮書」(陳等 2012)，是臺灣首份淡水魚類紅皮書報告。該版本共評估 115 個物種，依據「野生動物評估分類作業要點」的淡水魚類附表，以野生族群分布模式、棲地內優勢度現況、野生族群族群趨勢、分類地位及面臨威脅等五大指標進行初評，並且邀請專家學者討論後，最後共列出 52 種受脅魚類，其中極危 (Critical Endangered, CR) 有 3 種， 瀕 危 (Endangered, EN) 有 3 種，易危 (Vulnearable, VU) 有 31 種， 近危 (Near Threatened, NT) 有 15 種。其中並且有 10 種被列為國家法定的保育類野生動物。

該報告雖非完全依照 IUCN 的準則進行評估，但在五大指標內已經涵蓋 IUCN 的精神與評估模式在內，其評估結果並且與保育類名錄的修正並且互相配合，為臺灣淡水魚類受脅的種類與狀態評估奠定基礎。本次報告則引入 IUCN 紅皮書受脅與評估系統 (IUCN Red List of Threatened Species™) 的方式，蒐集及更新臺灣所有原生淡水魚的分布範圍、族群趨勢、數量與受脅原因等資訊，依據 IUCN 類別與標準評估各淡水魚種的最新受脅狀態。以系統且量化的評估方式建立合適於國內使用的標準作業程序 (S.O.P.) 及可以持續利用的物種評估資料庫。在可以與國際主流接軌的同時，也以臺灣尺度進行淡水魚類受脅現況的評估。

2. 評估流程

本報告執行臺灣各淡水魚種或亞種受脅狀態的評估流程與方法簡述如下：

2.1 界定納入評估之分類群

首先由臺灣物種名錄 (邵 2009)(TaiBNET，http://taibnet.sinica.edu.tw/home.php) 中取得臺灣目前已發表之所有魚類名錄，再依據臺灣淡水及河口魚類誌 (陳與方 1999) 及參考台灣淡水及河口魚圖鑑 (周與高 2011)、Catalog of fishes(Eschmeyer *et al*. 2017) 和臺灣魚類資料庫 (邵 2017)(http://fishdb.sinica.edu.tw/chi/home.php) 中對於生活史的資料與描述，選擇可以或曾經在淡水域出現過的所有種類。

學名參考臺灣魚類資料庫為主，輔以 Catalog of fishes 對各物種學名狀態之整理進行資料訂正。

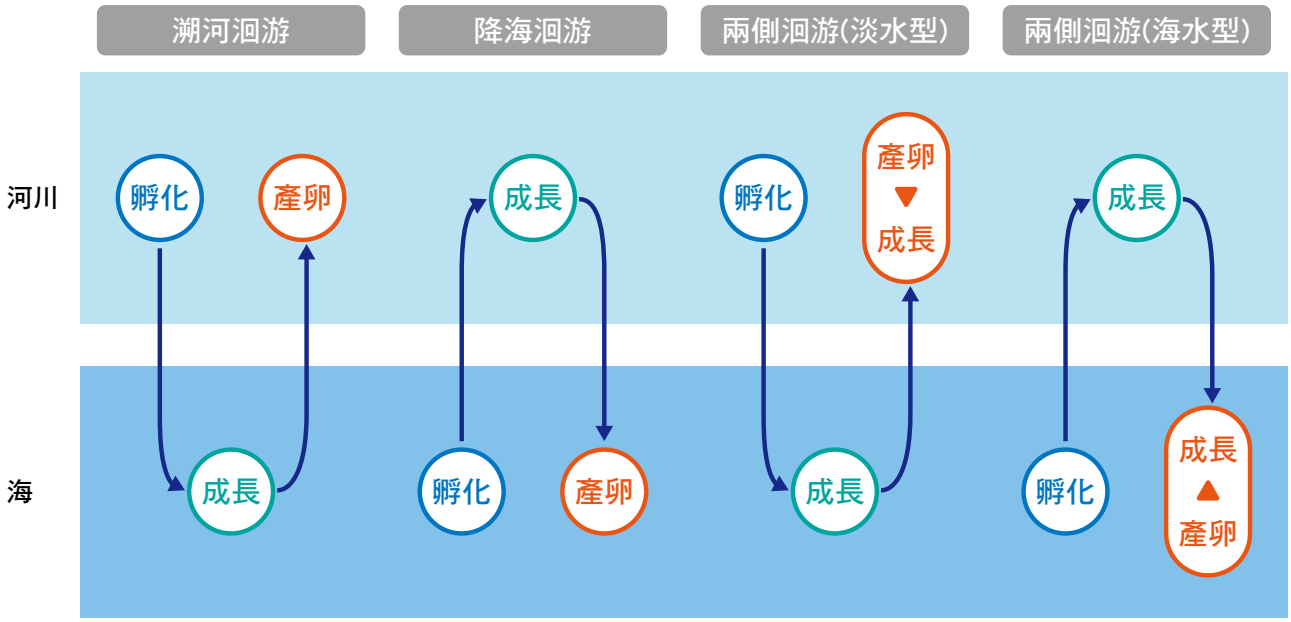
依照上述條件初步篩選得到的魚種清單有 262 種。但因淡水魚類的生活史十分多樣，因此初步篩選出來的魚種包含會在純淡水環境，以及河海之間的半淡鹹水出現的所有種類；在洄游習性上面，則包含有河海洄游的種類 (降海、溯河以及兩側洄游種類)，以及不會進行洄游，或是僅在河川內移動的種類。由於本次紅皮書名錄在淡水魚類所設定的目標為評估淡水魚類在淡水域環境內的變動狀況，因此需針對這 262 種淡水魚再進一步篩選。

廣義的淡水魚包含生活史型態，如果以鹽度耐受性與否，可以分成三種，分別是：(1) 初級淡水魚 (primary freshwater fish)：指終其一生都僅棲息在淡水環境的種類。(2) 次級淡水魚 (secondary freshwater fish)：幾乎只生活在淡

Oncorhynchus masou formosanus
臺灣櫻花鉤吻鮭 Formosan landlocked salmon
NEN B1ac(ii,iv) +2ac(ii,iv)[+1]
楊正雄 / 攝

水水域，但可耐受，或偶爾可進入鹹淡水或海水中活動或棲息。(3) 周緣性淡水魚 (peripheral freshwater fish)：主要在海水或半淡鹹水環境中棲息，但其生活史可能會游進淡水域中生存，或是進入鹹淡水域中活動，這包含部分溯河性魚類、降海性魚類以及偶見於河川的汽水域 (brackish water) 魚類。這些可以在河海之間移動的種類，可再依照其移動的方向分成以下三類：(1) 溯河洄游 (anadromous) 淡水魚：由海洋上溯至河川裡進行繁殖的種類，例如：洄游型鮭魚。(2) 降海洄游 (catadromous) 淡水魚：由河川下降至海洋裡進行繁殖的種類，例如：鰻鱺。(3) 兩側洄游 (amphidromous) 淡水魚：並非為了生殖目的，但可由海洋上溯至河川，或是由河川下降至海洋的種類。絕大多數的鰕虎科魚類等即屬此類。其中兩側洄游的魚類眾多，且其生活史型態更為多樣，亦有研究依照其生殖地點再細分為淡水性兩側洄游 (指在淡水環境繁殖的種類)，以及海水性兩側洄游 (指在海水環境繁殖的種類)。其分類說明如圖 2。

圖 2　洄游型態分類示意圖 (修改自後藤等 1994)。



由上述說明，定義本次紅皮書名錄納入評估的淡水魚包含：(1) 可在淡水環境完成整個生活史的種類，亦即初級淡水魚，沒有在河海之間洄游移動的魚類。(2) 可在河海之間洄游，但是在淡水環境進行繁殖 (產卵及孵化) 的魚類，亦即溯河洄游與淡水型的兩側回遊種類。(3) 降海洄游種類的魚類也納入評估，因其雖未在河川中繁殖，但其所有個體都必須在淡水環境中成長，且停留時間並不算短，如以降海洄游的鰻魚來說，達數年至數十年。相對來說，海水型的兩側洄游種類，通常僅族群中的少數個體會進入到淡水中，且其在淡水域的時間不會太久，有時需要在特定季節才會淡水環境中見到。因此本報告在評估時，將海水性兩側洄游種類排除掉。

雖然兩側洄游是評估名單的篩選條件，但在臺灣周邊或是河川內可以紀錄到的兩側洄游種類，有不少種類其實際的生活史狀況並不清楚，在參考臺灣魚類紅皮書 (陳等 2012) 及有限的觀察資料，以下 6 種鰕虎科魚類，因其可在河川內發現成熟個體。故也納入評估清單內，這 6 種包含：棘鱗裂唇鯊鰕虎 (*Lentipes armatus*)、黏皮輜鰕虎 (*Mugilogobius myxodermus*)、寬帶裂身鰕虎 (*Schismatogobius ampluvinculus*)、羅氏裂身鰕虎 (*Schismatogobius roxasi*)、環帶瓢眼鰕虎 (*Sicyopus zosterophorus*)、糙體銳齒鰕虎 (*Smilosicyopus leprurus*)。

評估的分類單元原則為「種」，但國土範圍內同時有特有亞種及其他亞種出現時則分別評估。另繁殖與訪問 (遷徙且無繁殖) 族群可區分時，亦依據 IUCN 國家或區域紅皮書標準應用指南 (IUCN 2012a) 之建議分別評估。若同時有外來種與原生種族群分布於國土範圍內，僅針對原生種族群進行評估。

其中香魚 (*Plecoglossus altivelis altivelis*) 因為在臺灣的原生族群已經滅絕，目前族群是 1984 年自日本再引進成功。由於臺灣的香魚並未確定特有性，與日本及其他地方的族群有相同的學名，這些現存香魚屬於再引入的外來族群 (Re-introduced population)，因此本報告依照 IUCN 文件的規範建議 (IUCN Standards and Petitions Subcommittee 2016)，將此種納入在評估名單之中，但不使用現生族群資料。

除了遷留屬性 (洄游與否) 的考量之外，IUCN 在地區性評估名單條件篩選上也可設定數量門檻，遷徙性物種的數量若沒有超過預設的門檻的話，就可能被視為是偶然發生的狀況 (Vagrant)。本報告因為已彙集的淡水魚資料中，並無足夠或是基準一致的定量族群資料可以比較。因此並不設定門檻數量做為篩選條件。

依據上述對淡水魚生活史的類別說明，依照 IUCN 國家或區域紅皮書標準應用指南 (IUCN 2012a) 的建議流程，排除具表 1 所列特性的魚種或亞種，其餘出現於我國國土涵蓋範圍內之初級淡水魚、溯河洄游淡水魚、兩側洄游河川型淡水魚、降海洄游淡水魚等都納入評估清單中，合計共有 95 種。

表 1. 排除正式評估之篩選條件

遷留屬性	其他條件
繁殖	1、外來種 (包含水族觀賞或是養殖逸出，或是人為放養的非原生種類)
	2、兩側洄游種類，其生活史目前無法確定是海水型或淡水型的種類。
洄游 (遷徙) 且無繁殖	1、兩側洄游海水型種類。有些兩側洄游種類，並不確定是否有淡水繁殖狀況者，暫不列入此次評估清單。
	2、通常視為海水魚，但仍有部分族群會進入淡水域活動的種類。

2.2 資訊蒐集與初步評估

依據 IUCN Red List Categories and Criteria: Version 3.1 (IUCN 2012b) 與 IUCN 國家或區域紅皮書標準應用指南 (IUCN 2012a)，建立評估資料表，並進行上述列入評估名單物種的各項資料蒐集。

本報告評估空間範圍為中華民國實質控制的陸、海領域，包括臺灣本島及周遭島嶼，如澎湖、蘭嶼及綠島，及鄰近中國大陸的金門及馬祖。本報告評估點位與文獻資料涵蓋 1915 年至 2014 年間。

每一受評分類群均依照 IUCN 紅皮書指南第 12 版進行評估 (IUCN Standards and Petitions Subcommittee 2016)。評估流程係由包括：A. 快速族群下降 (Rapid population reduction)、B. 分布侷限、碎裂化，同時存在族群下降或嚴重波動 (Small range and fragmented, declining, or extreme fluctuations)、C. 小族群且持續下降 (Small population and declining)、D. 非常小的族群 (Very small population)，以及 E. 量化分析 (Quantitative analysis) 等五大標準 (Criterion) 及對應次要標準 (Sub-criterion) 及方式 (Qualifiers) 所構成之決策樹 (logic tree) 進行 (表 2)。

某一分類群經過準則的評估後，若無法符合國家極危 (Nationally Critical, NCR)、國家瀕危 (Nationally Endangered, NEN) 及國家易危 (Nationally Vulnerable, NVU) 的類別，但已很接近或未來可能達到國家易危類別時，可列入國家接近受脅 (Nationally Near-threatened, NNT) 類別。由於 IUCN 紅皮書類別及標準 (IUCN Red List Categories and Criteria) 並無明確的接近受脅 (Near Threatened, NT) 標準，本報告根據前述原則並參考 IUCN 紅皮書類別及標準設定本評估 NNT 的標準 (表 2)。

表 2 IUCN 紅皮書受脅 (極危、瀕危、易危) 及接近受脅類別評估標準簡要內容。修正自 IUCN Standards and Petitions Subcommittee (2016)

物種紅皮書受脅類別判定標準	極危 (CR)	瀕危 (EN)	易危 (VU)	接近受脅 (NT)
A. 族群量下降 (時間區間為 10 年或 3 個世代，以較長者為優先)				
A1	≥ 90%	≥ 70%	≥ 50%	≥ 30%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%	≥ 20%

A1. 經由以下列舉任何方式所觀察、推估、推測或懷疑物種族群下降已經發生，而造成下降的原因明顯是可逆的且原因已知並且停止：
- (a) 直接觀察。［A3 除外］
- (b) 適合該分類群的物種豐度指數。
- (c) 分布範圍、占有面積或棲地品質減少或下降。
- (d) 實際或潛在的開發破壞。
- (e) 直接觀察受外來種、雜交種、病原、污染源、競爭者或寄生物之影響。

A2. 經由 A1 所列舉任何方式所觀察、推估、推測或懷疑物種族群降低已經發生，但造成降低的原因仍未停止、不明或不可逆。

A3. 經由 A1 所列舉任何方式所預估、推測或懷疑物種族群未來近期內會降低。(時間最長為 100 年)

A4. 經由 A1 所列舉任何方式所觀察、推估、推測或懷疑物種族群未來任何一段時間會降低，造成降低的原因仍未停止、不明或不可逆。

物種紅皮書受脅類別判定標準	極危 (CR)	瀕危 (EN)	易危 (VU)	接近受脅 (NT)
B. 分布範圍之判定標準 (至少具備 B1 或 B2 其中之一的條件)				
B1. 分布範圍 (EOO)	< 100 平方公里	< 5,000 平方公里	< 20,000 平方公里	<20,000 平方公里
B2. 占有面積 (AOO)	< 10 平方公里	< 500 平方公里	< 2,000 平方公里	< 2,000 平方公里
且族群需遭遇以下至少兩種情況 (至少一種狀況適用於 NT 類別)				
(a) 嚴重破碎化或居留區數目為右項數值者	= 1	≤ 5	≤ 10	≤ 10
(b) 經由觀察、推估、推測或預估，下列各項情況之一的數值仍持續下降者：(i) 分布範圍；(ii) 占有面積； (iii) 棲地之區域、實際面積或品質；(iv) 生長地點或亞族群之數目；(v) 能繁殖之成熟個體數				
(c) 下列各項情況其中之一的數值呈現劇烈變動時：(i) 分布範圍；(ii) 占有面積；(iii) 生長地點或亞族群之數目；(iv) 能繁殖之成熟個體數				
C. 族群量小且下降之判定標準				
族群內之成熟個體數	< 250	< 2,500	< 10,000	<20,000
且具備 C1 或 C2 其中之一的條件				
C1. 經由觀察、推估或預估物種族群成熟個體數持續下降。(時間至少為未來 100 年)	3 年或下一代 下降 25%	5 年或下二代 下降 20%	10 年或下三代 下降 10%	10 年或下三代 下降 10%
C2. 經由觀察、推估或預估，能繁殖之成熟個體數持續下降，而且其族群結構遭遇下列至少一種情況者：				
a(i) 每個亞族群能繁殖之成熟個體數	≤ 50	≤ 250	≤ 1,000	≤ 1,000
a(ii) 成熟個體都生長在一個單獨的小族群內所占比例	90%	95%	100%	100%
(b) 成熟個體呈現劇烈變動				
D. 族群數量極少且分布侷限之判定標準				
族群遭遇以下情況：				
D. 成熟個體數	< 50	< 250	D1. < 1,000	D1. < 2,500
與／或遭遇以下情況：				
D2. 出現面積受限或位於居留區的物種族群在未來有可能會面臨威脅，使之受脅程度提升至極危或瀕危類別 (此準則只用於評估易危及接近受脅類別)。	NA	NA	D2. 占有面積 < 20km^2 或分布地點≤ 5	D2. 占有面積 < 50km^2 或分布地點≤ 10
E. 量化分析				
在野外絕種之機率	10 年內或三個世代內在野外絕種之機率超過 50%	20 年內或五個世代內在野外絕種之機率超過 20%	100 年內在野外絕種之機率超過 10%	100 年內在野外絕種之機率超過 5%

2.3 類別調整原則

依據資料完成初步評估後，需進一步考慮受評估分類群的區域滅絕機率受到評估範圍外相同分類群其他族群的影響程度 (IUCN 2012a)。其目的主要在於瞭解評估區域內的族群在特定時間內 (通常是 10 年或 3 代內) 與範圍外族群是否有交流情況，當無交流情況時，則維持步驟 2.2 所評估類別結果。但若有交流情況，則遷入 (或是以任何形式) 個體預期不會減少且本地族群也沒有持續下降的情況時 (sink population)，其滅絕機率預期應會降低，故受脅類別將調降一級。

依照上述的說明，以及依照 IUCN(2012a) 建議流程，說明臺灣淡水魚類評估時的地區調整流程與原則如下：

1. 特有種或特有亞種，除非有特殊狀況，不然不予調整類別，維持步驟 2.2 之評估類別結果。
2. 非屬特有 (亞) 種，則依據其移動能力及與範圍外族群的交流狀況調整。此部分包含兩種考量，分別是生活史類型，以及是否有放流活動補充族群。分別說明如下：
   (1) 生活史類型中具有洄游時期的種類，若為降海洄游的種類，因為其繁殖地點並非在河川中，因此族群會每年因補充量多寡而有所差異。因此會依據本地所占全球族群比例，進行調整。如果臺灣族群有超過全球 5% 以上的族群，則其評估類別將會提高；若為 1 ～ 5% 以內，則維持原評估不變；若 <1%，則將類別降低。
   (2) 除了自然擴散，或是洄游性魚類會有自然補充族群的狀況外，許多淡水魚類都會面臨人為放流的狀況，因此在地區性評估時，也將此點納入考量。復育放流，視情況而定，若為原棲地放流，或是歷史棲地放流，則將類別調降一級。若非復育放流 (如養殖或是放生性，或是可能會有水族或養殖逸出的情況)，或是可能會有雜交的情況時，視依據實際情況，調降一至二級 (以 [+1] 或 [+2] 表示)。
3. 在最後評估名錄中，各種淡水魚類所列類別為調整之後的類別。若有經地區性調整的種類，在評估標準欄位中，將另外註記。如受脅類別提高一級則以 [-1] 表示，受脅類別調降 1 級者以 [+1] 表示。依此類推。降級後物種，依據國家接近受脅 (NNT) 定義，區別屬於 NNT 或國家暫無危機 (National Least Concern, LC) 類別。

2.4 公開意見徵詢

經由步驟 2.1 至 2.3 產生的評估結果於 2016 年 12 月至 2017 年 6 月間，由臺灣相關專家仔細審視收錄資料的正確性及補充闕失資訊，並於 2017 年 7 月辦理公開論壇，廣泛徵求魚類學家、民間團體及政府部門意見，最後再依據更新之資訊，再次執行步驟 2.1 至 2.3 產生本評估報告初稿。

3. 臺灣淡水魚類評估結果

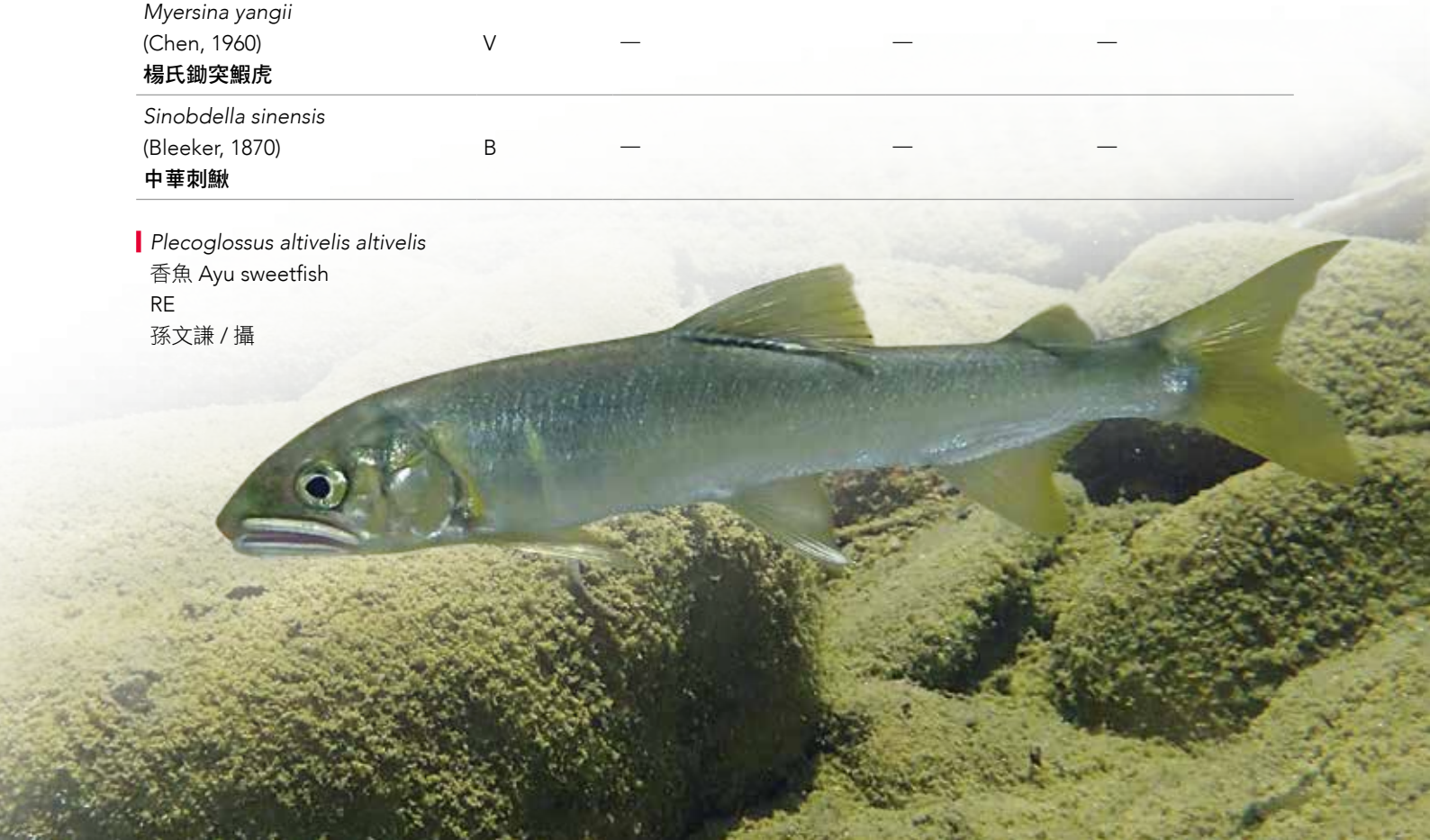
評估結果顯示臺灣有 4 種或亞種淡水魚類已經滅絕，其中 1 種屬於滅絕 (Extinct)，3 種屬於地區性滅絕 (Regionally Extinct)。25 種或亞種為國家受脅 (Nationally Threatened) 淡水魚類，其中屬國家極危 (Nationally Critical) 類別有 4 種，屬國家瀕危 (Nationally Endangered) 類別有 12 種，屬國家易危 (Nationally Vulnerable) 類別有 9 種，另有 11 種歸於國家接近受脅 (Nationally Near-threatened)。國家受脅及接近受脅淡水魚類種數分別占評估淡水魚種數的 26.3 % 及 11.6 %，以及總淡水及河口魚種數的 9.5 % 及 4.1%。45 種列為暫無危機 (Least Concern)；10 種列為資料缺乏 (Data Deficient)。

3.1 滅絕 (EX) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Salanx acuticeps (Bleeker, 1870) **銳頭銀魚**	B	—	—	>70

3.2 地區性滅絕 (RE) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Plecoglossus altivelis altivelis (Temminck & Schlegel, 1846) **香魚**	B	—	—	—
Myersina yangii (Chen, 1960) **楊氏鋤突鰕虎**	V	—	—	—
Sinobdella sinensis (Bleeker, 1870) **中華刺鰍**	B	—	—	—



Plecoglossus altivelis altivelis
香魚 Ayu sweetfish
RE
孫文謙 / 攝

3.3 國家極危 (NCR) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Anguilla japonica Temminck & Schlegel, 1846 **日本鰻鱺**	V	A2ab	EN	<20
Aphyocypris amnis Liao, Kullander & Lin, 2011 **溪流細鯽**	B	C1	—	>70
Squalidus banarescui Chen & Chang, 2007 **巴氏銀鮈**	B	B2ab(ii)	—	>70
Rhinogobius lanyuensis Chen, Miller & Fang, 1998 **蘭嶼吻鰕虎**	B	B1ab(iii)+2ab(iii)	—	>70

3.4 國家瀕危 (NEN) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Aphyocypris kikuchii (Oshima, 1919) **菊池氏細鯽**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Gobiobotia cheni Banarescu & Nalbant, 1966 **陳氏鰍鮀**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Metzia formosae (Oshima, 1920) **臺灣梅氏鯝**	B	B2ab(ii)	LC	>70
Pararasbora moltrechti Regan, 1908 **臺灣副細鯽**	B	B1ab(i,ii,v)+2ab(i,ii,v);	—	>70
Puntius semifasciolatus (Günther, 1868) **半紋小鲃**	B	B1ab(i,ii)+2ab(i,ii)	LC	<1
Puntius snyderi Oshima, 1919 **斯奈德小鲃**	B	B1ab(i,ii)+2ab(i,ii)	—	<20?
Hemimyzon taitungensis Tzeng & Shen, 1982 **臺東間爬岩鰍**	B	A3e+4e	VU	100
Liobagrus formosanus Regan, 1908 **臺灣鮡**	B	B1ab(ii)+2ab(ii)	—	>70
Rhinogobius delicatus Chen & Shao, 1996 **細斑吻鰕虎**	B	B2ab(i,ii)	—	>70

3.4 國家瀕危 (NEN) 類別淡水魚類名錄 (續)

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Rhinogobius henchuenensis Chen & Shao, 1996 **恆春吻鰕虎魚**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Rhinogobius nantaiensis Aonuma & Chen, 1996 **南台吻鰕虎**	B	B1ab(i)+2ab(i)	—	>70
Oncorhynchus masou formosanus (Jordan & Oshima, 1919) **臺灣櫻花鉤吻鮭**	B	B1ac(ii,iv) +2ac(ii,iv)[+1]	CR	>70

Metzia formosae
臺灣梅氏鯝 Taiwan lesser-bream
NEN B2ab(ii)
孫文謙 / 攝

Aphyocypris kikuchii
菊池氏細鯽 Taiwan Venus fish
NEN B1ab(i,ii)+2ab(i,ii)
張大慶 / 攝

3.5 國家易危 (NVU) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Formosania lacustre (Steindachner, 1908) **纓口臺鰍**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Hemimyzon formosanus (Boulenger, 1894) **臺灣間爬岩鰍**	B	B2ab(i,ii)	—	>70
Tachysurus adiposalis (Oshima, 1919) **長脂擬鱨**	B	B1ab(ii)+2ab(ii)	LC	<20?
Distoechodon tumirostris Peters, 1881 **圓吻鮈**	B	B1ab(i,ii)+2ab(i,ii)[+1]	LC	<1
Metzia mesembrinum (Jordan & Evermann, 1902) **大鱗梅氏鯊**	B	C1[+1]	—	<20
Sinibrama macrops (Günther, 1868) **大眼華鯊**	B	B1ab(ii)+2ab(ii)[+1]	LC	<1
Opsariichthys kaopingensis Chen & Wu, 2009 **高屏馬口鱲**	B	D2	—	>70
Oryzias latipes (Temminck & Schlegel, 1846) **青鱂**	B	B1ab(ii)+2ab(ii)[+1]	LC	<1
Channa asiatica (Linnaeus, 1758) **七星鱧**	B	B2ab(i,ii)[+1]	LC	<1

Channa asiatica
七星鱧 Small snakehead
NVU B2ab(i,ii)[+1]
周銘泰 / 攝

3.6 國家接近受脅 (NNT) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Microphysogobio brevirostris (Günther, 1868) **短吻小鰾鮈**	B	B1b(i,ii)+2b(i,ii)	—	>70
Onychostoma alticorpus (Oshima, 1920) **高身白甲魚**	B	B1a+2a	EN	>70
Onychostoma barbatulum (Pellegrin, 1908) **臺灣白甲魚**	B	A2bc; B1b(i,ii,v)+2b(i,ii,v)	—	<1
Gobiobotia kolleri Banarescu & Nalbant, 1966 **科勒氏鰍鮀**	B	B1a+2a	—	<5
Rhodeus ocellatus ocellatus (Kner, 1867) **高體鱊鮍**	B	B1b(i,ii)+2b(i,ii)	DD	<1
Sinogastromyzon nantaiensis Chen, Han & Fang, 2002 **南臺中華爬岩鰍**	B	B1a+2a	—	>70

Sinogastromyzon nantaiensis
南臺中華爬岩鰍 Southern Taiwan Chinese stream loach
NNT B1a+2a
孫華 / 攝

3.6 國家接近受脅 (NNT) 類別淡水魚類名錄 (續)

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Sinogastromyzon puliensis Liang, 1974 **埔里中華爬岩鰍**	B	B1a+2a	VU	>70
Silurus asotus Linnaeus, 1758 **鯰**	B	B2b(i,ii)	LC	<1
Lentipes armatus Sakai & Nakamura, 1979 **棘鱗裂唇鯊鰕虎**	B	B2a	—	<20?
Rhinogobius formosanus Oshima, 1919 **臺灣吻鰕虎**	B	B1a+ 2a	DD	>70
Macropodus opercularis (Linnaeus, 1758) **蓋斑鬥魚**	B	B2ab(i,ii)[+2]	LC	<1

Sinogastromyzon puliensis
埔里中華爬岩鰍 Pulin river loach
NNT B1a+2a
周銘泰 / 攝

3.7 國家無危 (NLC) 類別淡水魚類名錄

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Mugilogobius myxodermus (Herre, 1935) **黏皮鰕虎**	B	B2a[+1]	—	<5?
Schismatogobius ampluvinculus Chen, Shao & Fang, 1995 **寬帶裂身鰕虎**	V	B1a+2a[+1]	—	<5?
Schismatogobius roxasi Herre, 1936 **羅氏裂身鰕虎**	V	B1a+2a[+1]	—	<5?
Sicyopus zosterophorus (Bleeker, 1856) **環帶瓢眼鰕虎**	B	B1a+2a[+1]	—	<1
Sicyopterus japonicus (Tanaka, 1909) **日本瓢鰭鰕虎**	B	B1b(i,ii)+2b(i,ii)[+1]	—	<1
Stenogobius sp. **頰斑細鰕虎**	B	B1a+2a[+1]	—	<1
Channa maculata (Lacepède, 1801) **斑鱧**	B	B2b(ii) [+1]	LC	<1
Anguilla marmorata Quoy & Gaimard, 1824 **花鰻鱺**	V	—	LC	<1
Acrossocheilus paradoxus (Günther, 1868) **臺灣石鯽**	B	—	—	>70

Anguilla marmorata
花鰻鱺 Giant mottled eel
NLC
周銘泰 / 攝

3.7 國家無危 (NLC) 類別淡水魚類名錄 (續)

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Candidia barbata (Regan, 1908) **臺灣鬚鱲**	B	—	—	>70
Carassius auratus auratus (Linnaeus, 1758) **鯽**	B	—	LC	—
Chanodichthys erythropterus (Basilewsky 1855) **紅鰭鮊**	B	—	LC	<1
Cyprinus carpio carpio Linnaeus, 1758 **鯉**	B	—	VU	—
Hemibarbus labeo (Pallas, 1776) **唇鮈**	B	—	—	<1
Hemiculter leucisculus (Basilewsky, 1855) **鱎**	B	—	LC	<1
Microphysogobio alticorpus Banarescu & Nalbant, 1968 **高身小鰾鮈**	B	—	—	>70
Opsariichthys evolans (Jordan & Evermann, 1902) **長鰭馬口鱲**	B	—	—	<1
Opsariichthys pachycephalus Günther, 1868 **粗首馬口鱲**	B	—	—	>70
Pseudorasbora parva (Temminck & Schlegel, 1846) **羅漢魚**	B	—	LC	<1
Spinibarbus hollandi Oshima, 1919 **何氏棘鮈**	B	—	DD	<5
Tanakia himantegus (Günther, 1868) **革條田中鱓鮍**	B	—	—	<1
Cobitis sinensis Sauvage & Dabry de Thiersant, 1874 **中華鰍**	B	—	LC	<1
Misgurnus anguillicaudatus (Cantor, 1842) **泥鰍**	B	—	LC	<1

3.7 國家無危 (NLC) 類別淡水魚類名錄 (續)

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Paramisgurnus dabryanus Dabry de Thiersant, 1872 **大鱗副泥鰍**	B	—	—	<1
Tachysurus brevianalis Regan, 1908 **短臀擬鱨**	B	—	—	>70
Monopterus albus (Zuiew, 1793) **黃鱔**	B	—	LC	<1
Rhyacichthys aspro (Valenciennes, 1837) **溪鱧**	B	—	DD	<1
Awaous melanocephalus (bleeker, 1849) **黑頭阿胡鰕虎**	B	—	—	<1
Eleotris acanthopoma Bleeker, 1853 **刺蓋塘鱧**	B	—	LC	<1
Eleotris fusca (Forster, 1801) **褐塘鱧**	B	—	LC	<1
Glossogobius celebius (Valenciennes, 1837) **盤鰭叉舌鰕虎**	B	—	DD	<1

Gobiobotia cheni
陳氏鰍鮀 Taiwan eight-barbel gudgeon
NEN B1ab(i,ii)+2ab(i,ii)
周銘泰 / 攝

3.7 國家無危 (NLC) 類別淡水魚類名錄 (續)

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Mugilogobius abei (Jordan & Snyder, 1901) **阿部氏鰕虎**	B	—	—	—
Oligolepis acutipennis (Valenciennes, 1837) **尖鰭寡鱗鰕虎**	B	—	DD	<1
Redigobius bikolanus (Herre, 1927) **拜庫雷鰕虎**	B	—	LC	<1
Rhinogobius candidianus (Regan, 1908) **明潭吻鰕虎**	B	—	—	>70
Rhinogobius gigas Aonuma & Chen, 1996 **大吻鰕虎**	B	—	—	>70
Rhinogobius giurinus (Rutter, 1897) **極樂吻鰕虎**	B	—	LC	<1
Rhinogobius maculafasciatus Chen & Shao, 1996 **斑帶吻鰕虎**	B	—	—	>70
Rhinogobius rubromaculatus Lee & Chang, 1996 **短吻紅斑吻鰕虎**	B	—	—	>70
Sicyopterus lagocephalus (Pallas, 1770) **兔頭瓢鰭鰕虎**	B	—	LC	<1
Sicyopterus macrostetholepis (Bleeker, 1853) **寬頰瓢鰭鰕虎**	B	—	—	<1
Stiphodon atropurpureus (Herre, 1927) **黑紫枝牙鰕虎**	B	—	—	<1
Stiphodon elegans (Steindachner, 1879) **美麗枝牙鰕虎**	B	—	—	<1
Stiphodon percnopterygionus Watson & Chen, 1998 **黑鰭枝牙鰕虎**	B	—	DD	<1
Culter alburnus Basilewsky, 1855 **翹嘴鮊**	B	B1b(i,ii)+2b(i,ii)[+1]	—	<1

3.8 數據缺乏 (DD) 類別

分類群	繁殖 (B) 非繁殖 (V)	評估標準	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Anguilla bicolor pacifica Schmidt, 1928 **太平洋雙色鰻鱺**	V	—	—	—
Anguilla celebesensis Kaup, 1856 **西里伯斯鰻鱺**	V	—	NT	<1
Anguilla luzonensis Watanabe, Aoyama & Tsukamoto, 2009 **呂宋鰻鱺**	V	—	NT	<1
Candidia pingtungensis Chen, Wu & Hsu, 2008 **屏東鬚鱲**	B	—	—	>70
Squalidus argentatus (Sauvage & Dabry de Thiersant, 1874) **銀鮈**	B	—	DD	<5
Squalidus iijimae (Oshima, 1919) **飯島氏銀鮈**	B	—	—	>70
Tanakia chii (Miao, 1934) **齊氏田中鱎鮍**	B	—	—	<1?
Hemimyzon sheni Chen & Fang, 2009 **沈氏間爬岩鰍**	B	—	—	>70
Smilosicyopus leprurus (Sakai &amp Nakamura, 1979) **糙體銳齒鰕虎**	B?	—	—	<20?
Anabas testudineus (Bloch, 1792) **攀鱸**	B	—	—	<1

Stiphodon percnopterygionus
黑紫枝牙鰕虎 Goby
NLC
孫文謙 / 攝

4. 臺灣全球受脅淡水魚類

本報告納入評估候選之 262 種淡水魚中有 6 種為全球受脅台灣鉤吻鮭及接近威脅淡水魚種，3 種屬國家受脅，2 種屬國家接近威脅。

分類群	繁殖 (B) 非繁殖 (V)	國家紅皮書類別	全球紅皮書類別	臺灣占全球 數量百分比 (種)
Anguilla japonica Temminck & Schlegel, 1846 **日本鰻鱺**	V	CR	EN	<20
Oncorhynchus masou formosanus (Jordan & Oshima, 1919) **臺灣櫻花鉤吻鮭**	B	EN	CR	>70
Onychostoma alticorpus (Oshima, 1920) **高身白甲魚**	B	NT	EN	>70
Cyprinus carpio carpio Linnaeus, 1758 **鯉**	B	LC	VU	<1
Hemimyzon taitungensis Tzeng & Shen, 1982 **臺東間爬岩鰍**	B	EN	NT	100
Sinogastromyzon puliensis Liang, 1974 **埔里中華爬岩鰍**	B	NT	VU	>70

Puntius semifasciolatus
半紋小鮕 Chinese barb
NEN B1ab(i,ii)+2ab(i,ii)
周銘泰 / 攝

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The Red List of Freshwater Fishes of Taiwan, 2017

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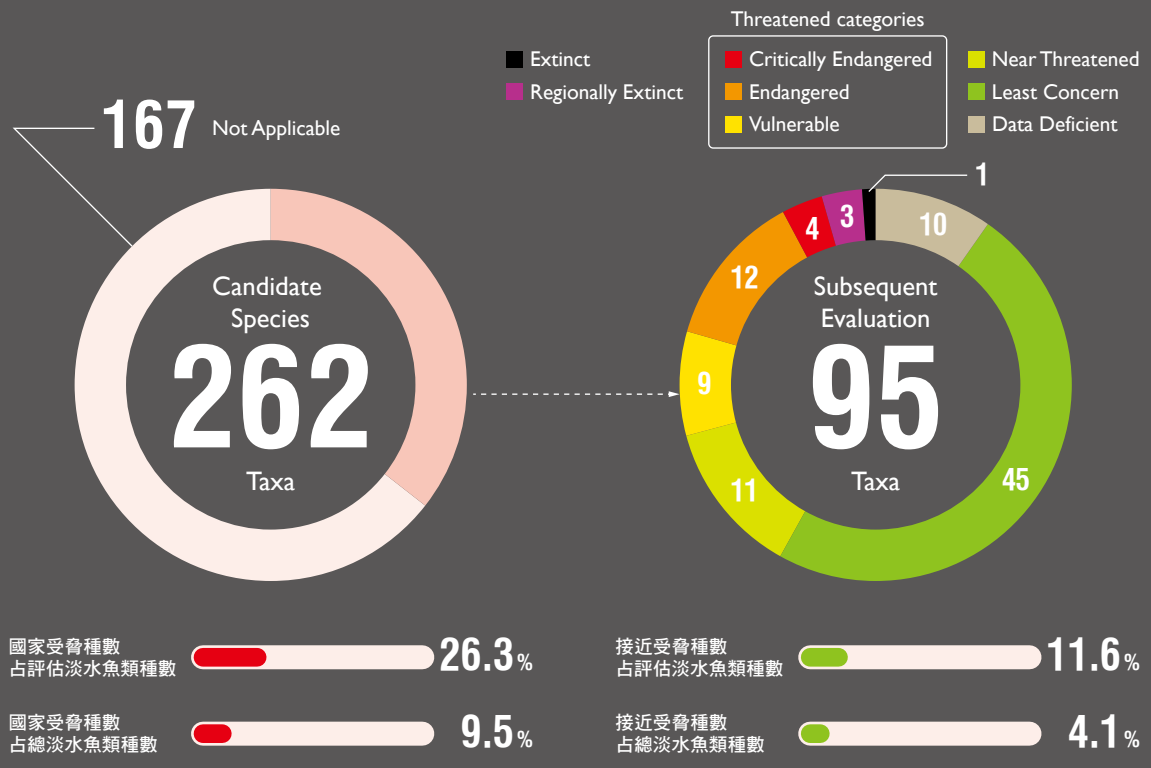
Abstract

This report is the first national Red List evaluation of all native freshwater fish species in Taiwan according to the categories and criteria recommended by the International Union for Conservation of Nature Red List of Threatened Species™. Among all 262 candidate species, 167 were identified as not applicable for the regional-Category Red List assessments, with only 95 remaining species eligible for the evaluation process. According to the results, among four extinct species, one was identified as Extinct and the other three were identified as Regionally Extinct. In addition, among 25 Nationally Threatened freshwater fish species (or subspecies), four Nationally Critical species, 12 Nationally Endangered species, nine Nationally Vulnerable species, and 11 Nationally Near-Threatened (NNT) species were identified. A further examination indicated that Nationally Threatened and NNT species accounted for 26.3% and 11.6% of the total freshwater fish species and 9.5% and 4.1% of the total freshwater and estuarine fish species, respectively. In addition, 45 were categorized as National Least Concern species, and ten were listed as data deficient. Six species were categorized as globally threatened and Near-threatened freshwater fish species by IUCN, among which three were Nationally Threatened and two were Nationally Near-threatened in Taiwan.



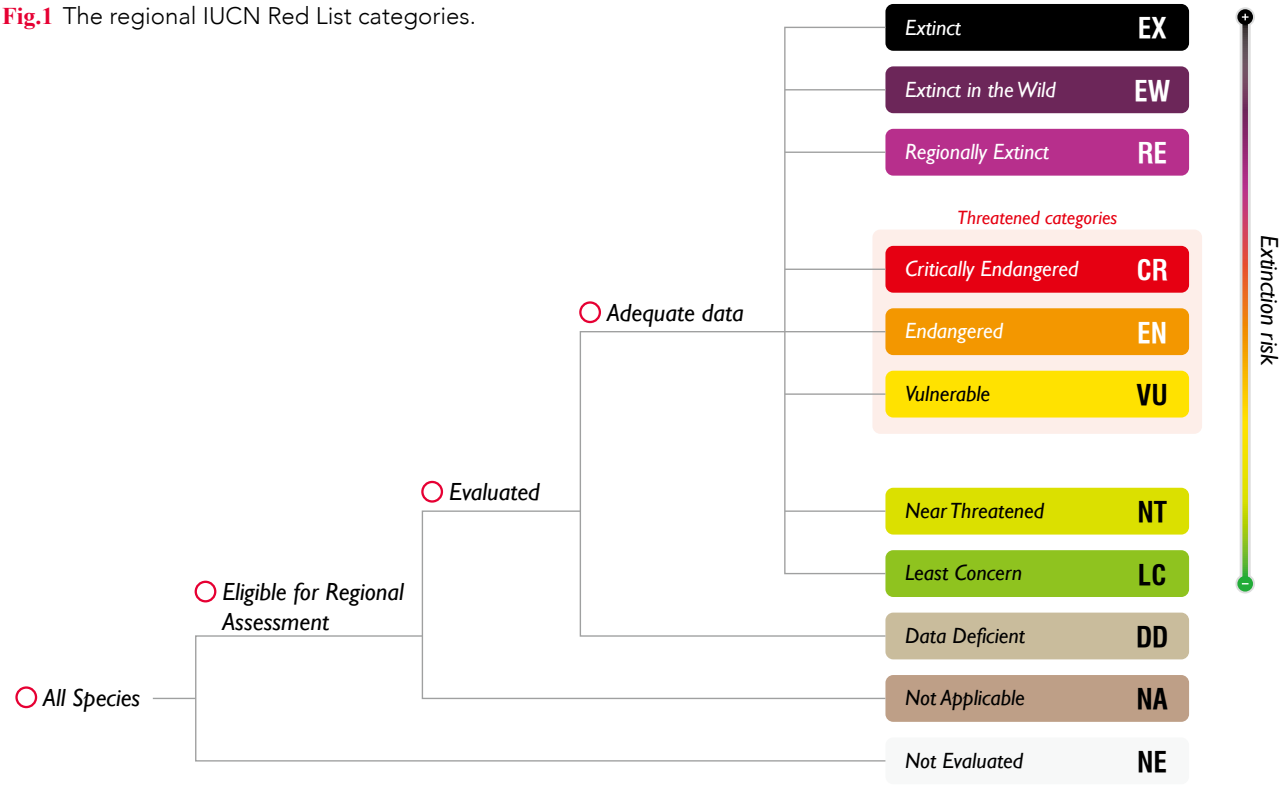
1. Introduction

The risk of extinction faced by a species or taxon is an essential topic of conservation management. Concise listings of taxa by threat categories provide a basis for prioritizing recovery programs and research, monitoring the adequacy of conservation measures, gaining support for habitat protection, and facilitating resource allocation (Townsend *et al*. 2007).

The Species Survival Commission of the International Union for Conservation of Nature (IUCN) is responsible for compiling the IUCN Red List of Threatened Species. Since its first publication in 1964, the list has gradually become a key reference for assessing the conditions and trends of threatened species on a global scale (Rodrigues *et al*. 2006; IUCN 2016). Moreover, the categories (Fig.1), assessment criteria and the regional guidelines published by the IUCN have been adopted by many countries as the primary basis for listing threatened species in their own territories (Townsend *et al*. 2007; IUCN 2012a). The standardized assessment method of the IUCN Red List not only facilitates formulating and executing conservation policies worldwide, but also improves the comprehensiveness of the assessment of the global conservation status of plant and animal species (Rodrigues *et al*. 2006).

When a country or region claims that its red list is compiled in accordance with the IUCN system, the classification process of the list must completely follow the IUCN Red List Categories and Criteria (IUCN 2012b). A regional-Category assessment pertains to any region on Earth with a clearly defined boundary, such as a continent, country, or state (IUCN 2012a). When the status assessment is redirected from the global scale to a local category, issues such as native or alien species, breeding or nonbreeding populations,

Fig.1 The regional IUCN Red List categories.



Squalidus banarescui
巴氏銀鮈 Central Taiwan gudgeon
NCR B2ab(ii)
張瑞宗 / 攝

and locally extinct species naturally emerge. (IUCN 2012a). The present report is compiled using the IUCN Red List Categories and Criteria: Version 3.1 (IUCN 2012b).

However, the assessment process and thresholds of the criteria might be inadequate for evaluating species whose distribution ranges extend beyond the defined spatial area; thus, adjustments were made using the Guidelines for Application of IUCN Red List Criteria at Regional and National Categories (IUCN 2012a).

Chen *et al.*(2012) investigated the conservation status of freshwater fish species and published the first official Red List of freshwater fish in Taiwan through the Forestry Bureau of Taiwan. In that report, a total of 115 freshwater fish species were evaluated according to the five criteria of the Operation Regulation for assessment and classification of wild freshwater fish (i.e., distribution pattern, degree of dominance in habitat, population trends, taxonomic status, and risk of extinction) and assessed through consultation with experts in Taiwan. Among the 52 threatened freshwater fishes specified in that report, three critically endangered (CR) species, three endangered (EN) species, 31 vulnerable (VU) species, and 15 near-threatened (NT) species were identified. In addition, ten were classified as nationally protected.

The results of Chen *et al.*'s (2012) report did not fully follow the IUCN Red Book guidelines. However, their five selected indicators were based on the concepts and assessment criteria of IUCN and were accomplished through expert assessment. Therefore, Chen *et al.*'s (2012) report underlies our assessment. In the present report, data table and standard operation procedure (S.O.P.) of assessment are created based on the IUCN Red List of Threatened Species™ that collects and updates information on the distribution, population trends, numbers and causes of threat of all native freshwater fish species in Taiwan, enabling the development of a system of conservation status assessment incorporating both international and local perspectives.

2. Assessment process

The process and method employed for assessing the conservation status of freshwater fish species or subspecies in Taiwan were as follows:

2.1 Defining the taxa to be included in the evaluation

A list of all fish species in Taiwan was first retrieved through a previously published catalog TaiBNET (Shao 2009)(http://taibnet.sinica.edu.tw/home.php). All current or past freshwater fish species were subsequently selected using related data and life history descriptions from *Freshwater and Estuarine Fishes of Taiwan* (Chen and Fang 1999), *Freshwater and Estuarine Fish of Taiwan* (Chou and Kao 2011), Catalog of Fishes (Eschmeyer *et al.* 2017) and the Fish Database of Taiwan (Shao 2017)(http://fishdb.sinica.edu.tw/chi/home.php).

All scientific names in this report were mainly inferred from the Fish Database of Taiwan and Catalog of Fishes.

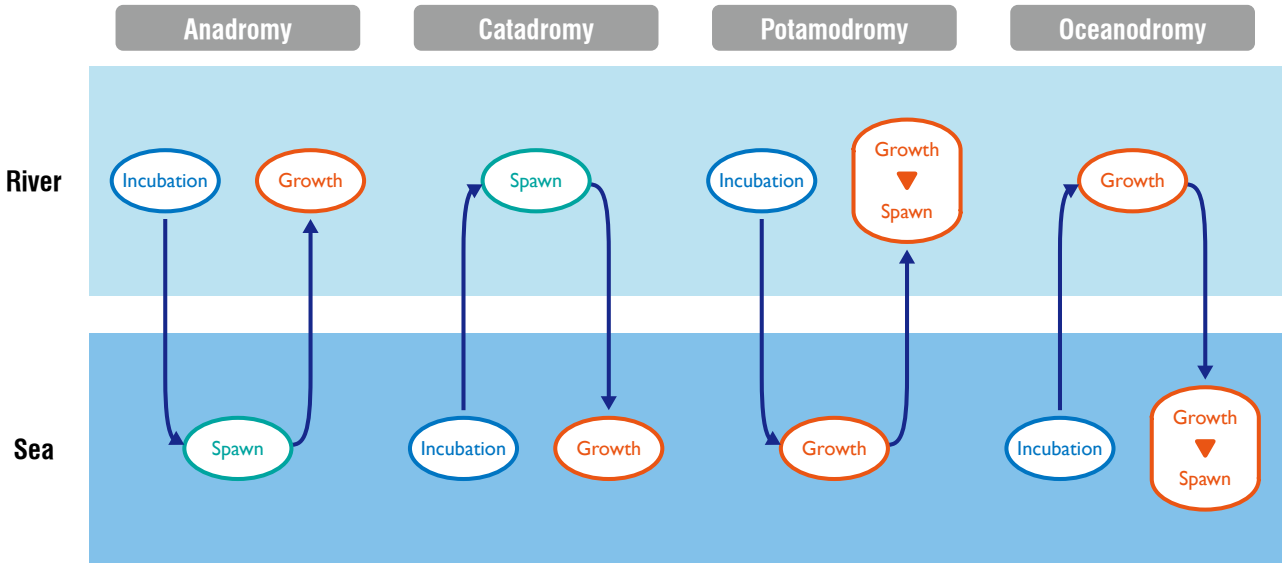
A total of 262 fish species were established based on the aforementioned databases and books including all freshwater and brackish water fishes, regarding different migratory habits (i.e., catadromous, anadromous, and amphidromous). The retrieved species list was further screened because this report was intended to evaluate the patterns of freshwater fishes only within freshwater environments.

Salinity tolerance in life history patterns among freshwater fish can be categorized into three types as follows: (1) primary freshwater fish: species that inhabit only freshwater environments in their life history; (2) secondary freshwater fish: species that inhabit mostly in freshwater, but are saline-tolerant and occasionally inhabit or are active in saltwater; (3) peripheral freshwater fish: species that mainly inhabit saltwater and brackish water, but may also exist in freshwater or enter brackish water in their life history, among which most

Oncorhynchus masou formosanus
臺灣櫻花鉤吻鮭 Formosan landlocked salmon
NCR B1ac(ii,iv) +2ac(ii,iv)[+1]
楊正雄 / 攝

are considered saltwater fishes, and some are anadromous and catadromous species. Moreover, species that migrate between fresh and salt waters can be further classified into three subtypes based on their migratory patterns, including: (1) anadromous freshwater fish: species that migrate upstream from the sea to rivers for reproduction (e.g., migratory salmon); (2)catadromous freshwater fish: species that migrate downstream to the sea for reproduction (e.g., Japanese eel) (3) amphidromous freshwater fish: species that also migrate upstream or downstream between the sea and freshwater, but their migration is irrelevant to the purpose of reproduction.(e.g., most amphidromous gobies listed in this report.) Amphidromous migration can be further divided into potamodromy and oceanodromy according to location of reproduction. Graphic classifications of catadromous, anadromous, and amphidromous are shown in Fig. 2.

Fig.2. Classification of fish migration (modified from Goto *et al*. 1994)



The target species of this report are primary freshwater fish and anadromous, catadromous or amphidromous species that spawn in freshwater. Despite not reproducing in freshwater, catadromous fishes were included in the assessment because catadromous fish undergoes a considerably long life history. For instance, Japanese eels may inhabit in freshwater for years. By contrast, oceanodromous fishes do not often appear in freshwaters for a long period, and were therefore excluded from this report.

In addition to migratory patterns, population size was also considered in the IUCN Red List criteria for regional-category assessment. Migratory species may be considered vagrants if the population size is lower than a certain threshold. However, in our report, setting population-size thresholds is not considered due to lack of corresponding data.

Although criteria for inclusion of amphidromous fish in the assessment were defined in the previous section, the criteria are actually not applicable to most amphidromous species in the Taiwanese waters due to their life history traits remaining unknown. However, inferred from the *Red List of Freshwater Fish of Taiwan* (Chen et al. 2012), mature adults of six gobies are commonly found in freshwaters and, therefore, included in the assessment. They are *Lentipes armatus*, *Mugilogobius myxodermus*, *Schismatogobius ampluvinculus*, *Schismatogobius roxasi*, *Sicyopus zosterophorus, and Silosicyopus leprurus*.

"Species" was the unit for IUCN evaluation. However, when there are subspecies, each of them was evaluated respectively. When breeding and visiting (migration without breeding) populations were distinguishable, they were evaluated separately according to the Guidelines for Application of IUCN Red List Criteria at Regional and National Categories (IUCN 2012a). When both alien and native conspecific populations were found to appear within the defined region, only the native population was evaluated.

Plecoglossus altivelis altivelis, a native species once extinct from Taiwan, has been successfully reintroduced from Japan since 1984. It was categorized as a reintroduced exotic population because its characteristics are unspecified and it shares the same scientific name with other groups of the species in Japan and other regions. *Plecoglossus a. altivelis* was thus included in this report according to the recommended standards of the IUCN Standards and Petitions Subcommittee 2016, but do not use the existed population data.

According to these life history classifications and the process recommended in the *Guidelines for Application of the IUCN Red List Criteria at Regional and National Categories* (IUCN 2012a), species or subspecies that exhibit the listed characteristics in Table 1 were excluded from subsequent assessment. Other remaining primary freshwater fish within the national territory of Taiwan including anadromous, amphidromous, and catadromous species were considered, and eventually, amounting to a total of 95 freshwater fish taxa.

Table 1. Exclusion criteria for the formal assessment

Migration Characteristics	Other Criteria
Reproduction	1. Non-native species, including invasive ornamental and aquacultural fishes, and artificial released species.
	2. Amphidromous species, due to lack of knowledge of life history traits to determine whether they are oceanodromous or potamodromous.
Migration (excluding reproduction)	1. Oceanodromous species without record of reproductive behavior in freshwater environments are temporarily excluded from this evaluation.
	2. Species that are often considered as marine fishes, but occasionally enter freshwaters are temporarily excluded from this evaluation.

2.2 Data collection and preliminary evaluation

A species list was prepared based on the *IUCN Red List Categories and Criteria: Version 3.1* (IUCN 2012b) and the *Guidelines for Application of the IUCN Red List Criteria at Regional and National Categories* (IUCN 2012a). Each species on the list was evaluated according to the process described below.

The geographical area of this report covers the land and sea under the jurisdiction of the government of the Republic of China (widely known as 'Taiwan'), including Taiwan Island and its adjacent islands (Penghu, Lanyu, and Ludao), and two groups of outlying islands near mainland China: Matsu islands and Kinmen islands. And the data collect duration covers since 1915 to 2014.

Every targeted species was assigned a preliminary threat category in accordance with the Guidelines for Using the IUCN Red List Categories and Criteria, Version 12 (IUCN Standards and Petitions Subcommittee 2016). The evaluation process involved using a logic tree constituted of the following criteria: A. Rapid population reduction; B. Small range and fragmented, declining, or extreme fluctuations; C. Small population and declining; D. Very small population; and E. Quantitative analysis. Each criterion also contained several subcriteria and qualifiers. When a species currently cannot be assigned to Nationally Critical (NCR), Nationally Endangered (NEN), or Nationally Vulnerable (NVU), but is likely to reach the NVU Category in the near future, it can be classified as Nationally Near-threatened (NNT). Because the IUCN Red List Categories and Criteria does not provide a clear standard for Near Threatened, the present report applies the aforementioned criteria and refers to the IUCN Red List Categories and Criteria to define NNT (Table 2).

Table 2. A simplified overview of Red List criteria adopted in this study. Modified from IUCN Standards and Petitions Subcommittee (2016)

Use any of the criteria A-E	Critically Endangered	Endangered	Vulnerable	Near Threatened
A. Population size reduction (declines measured over the longer of 10 years or 3 generations)				
A1	≥ 90%	≥ 70%	≥ 50%	≥ 30%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%	≥ 20%

A1. Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased, based on and specifying any of the following:

(a) direct observation. [except A3]

(b) an index of abundance appropriate to the taxon.

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality.

(d) actual or potential Categories of exploitation.

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

A2. Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3. Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]

A4. An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

Use any of the criteria A-E	Critically Endangered	Endangered	Vulnerable	Near Threatened
B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)				
B1. Extent of occurrence (EOO)	< 100 km^2	< 5,000 km^2	< 20,000 km^2	< 20,000 km^2
B2. Area of occupancy (AOO)	< 10 km^2	< 500 km^2	< 2,000 km^2	< 2,000 km^2
AND at least 2 of the following 3 conditions (at least one for Near-threatened category):				
(a) Severely fragmented OR # locations	= 1	≤ 5	≤ 10	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals				
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals				
C. Small population size and decline				
Number of mature individuals	< 250	< 2,500	< 10,000	< 20,000
AND at least one of C1 or C2				
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation	20% in 5 years or 2 generations	10% in 10 years or 3 generations	10% in 10 years or 3 generations
C2. An observed, estimated, projected or inferred continuing decline AND at least one of the following 3 conditions:				
a(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1000	≤ 1000
a(ii) % of mature individuals in one subpopulation =	90%	95%	100%	100%
(b) Extreme fluctuations in the number of mature individuals				
D. Very small or restricted population Either:				
D. Number of mature individuals	< 50	< 250	D1. < 1000	D1. < 2500
AND/OR				
D2. Only applies to the VU and NT category Restricted area of occupancy or number of locations with a plausible futrue threat that could drive the taxon to CR or EX in a very short time.	NA	NA	D2. AOO < 20 km^2 or number of locations ≤ 5	D2. AOO < 50 km^2 or number of locations ≤ 10
E. Quantitative Analysis				
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations (100 year max.)	≥ 20% in 20 years or 5 generations (100 year max.)	≥ 10% in 100 years	≥ 5% in 100 years

2.3 Categories adjusting

After the initial evaluation, further assessment was required to consider the effects of other populations outside the assessed range of a given taxon on the regionally extinct risk of evaluated populations (IUCN 2012a). The purpose was to understand whether a population of a given taxon within an assessed range and specified time (usually within 10 years or 3 generations) interacts with other populations beyond the range. When no interaction is observed, the analysis results of Process 2.2 are maintained; if an interaction can be identified, the number of recruited (or in any other form) individuals and likewise the population size are not expected to decline, and the risk of extinction and the threat category should consequently decrease.

From this explanation and the recommended process of the IUCN (2012a), the modified process and criteria adopted for the assessment of freshwater fish in Taiwan was as follows:

1. Categories of endemic species and subspecies remained as assessed in Process 2.2, except for special conditions.
2. Categories of non-endemic species or subspecies were modified regarding mobility and interaction with other populations beyond their assessed ranges. In addition, life history traits and stock enhancement are two additional concerns. First, due to spawning in the sea, the amount of juvenile recruitment for catadromous species may vary each year and, therefore, their threat category will be adjusted according to the regional–global proportion of the assessed species. If a taxon in Taiwan represents over 5% of the global population, the assessment category increases; if it is within 1–5%, the category remains unchanged; and if it is below 1%, the category decreases. Second, in addition to natural expansion or recruitment of migratory species, some freshwater fishes may have experienced stock enhancement, and this should also be considered in regional-category evaluation. When stock enhancement occurs in an original or historical habitat, the category will be lowered by one;; in the cases not aimed at stock enhancement (e.g., artificial breeding, religious release, or species released from domestication) or potential crossings, the category will be lowered by one or two (indicated as [+1] or [+2]) according to the actual circumstances.
3. In the final listing, the categories recorded for each freshwater fish species were the results of modification. Additional notes were taken in the assessment columns for species that were adjusted for regional assessment. An enhanced threat category was denoted as [−1] and a lowered threat category was [+1]. Species with lowered categories were categorized as NNT or National Least Concern.

2.4 Soliciting expert opinions

The categorization results obtained through the aforementioned procedures were examined by experts from December 2016 to June 2017, ensuring the adequacy of data collection and adding missing information. Knowledgeable individuals from the wider ichthyological community were invited to a workshop held in Taipei in late July 2017 to discuss the status of all candidate taxa. At the same time, the draft list and data for assessment were disseminated among the fish-hobbyist community to solicit comments. Finally, the updated data were used to repeat Process 2.1 – 2.3 to revise the categorization results and create this report.

3. Assessment results of freshwater fish species of Taiwan

The results revealed four extinct species of freshwater fish, one was identified as Extinct and three were identified as Regionally Extinct. Twenty five Nationally Threatened and 11 Nationally Near-threatened species or subspecies, corresponding to 26.3% and 11.6% of the evaluated taxa,or 9.5% and 4.1% of the total number of freshwater fish species in Taiwan. The conservation statuses of the evaluated species were grouped in accordance with the IUCN Red List Categories. There are four, 12 and 9 taxa ranked in Nationally Critical, Nationally Endangered and Nationally Vulneable, respectively. Fourty five were categorized as National Least Concern species, and ten were listed as data deficient. The classification system of the present report was based on the TaiBNET (Shao 2009), The complete evaluation results and the data table are available from the corresponding author.

3.1 List of Extinct freshwater fish taxa in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Salanx acuticeps Regan, 1908 **Icefish**	B	—	—	>70

3.2 List of Regionally Extinct in the wild freshwater fish taxa in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Plecoglossus altivelis altivelis (Temminck & Schlegel, 1846) **Ayu sweetfish**	B	—	—	—
Myersina yangii (Chen, 1960) **Goby**	V	—	—	—
Sinobdella sinensis (Bleeker, 1870) **Lesser spiny eel**	B	—	—	—

3.3 List of Nationally Critically Endangered freshwater fish taxa in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Anguilla japonica Temminck & Schlegel, 1846 **Japanese eel**	V	A2ab	EN	<20
Aphyocypris amnis Liao, Kullander & Lin, 2011 **Stream minnow**	B	C1	—	>70
Squalidus banarescui Chen & Chang, 2007 **Central Taiwan gudgeon**	B	B2ab(ii)	—	>70
Rhinogobius lanyuensis Chen, Miller & Fang, 1998 **Goby**	B	B1ab(iii)+2ab(iii)	—	>70

3.4 List of Nationally Endangered freshwater fish taxa in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Aphyocypris kikuchii (Oshima, 1919) **Taiwan Venus fish**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Gobiobotia cheni Banarescu & Nalbant, 1966 **Taiwan eight-barbel gudgeon**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Metzia formosae (Oshima, 1920) **Taiwan lesser-bream**	B	B2ab(ii)	LC	>70
Pararasbora moltrechti Regan, 1908 **Taiwan white minnow**	B	B1ab(i,ii,v)+2ab(i,ii,v);	—	>70
Puntius semifasciolatus (Günther, 1868) **Chinese barb**	B	B1ab(i,ii)+2ab(i,ii)	LC	<1
Puntius snyderi Oshima, 1919 **Snyder's barb**	B	B1ab(i,ii)+2ab(i,ii)	—	<20?

Metzia formosae
臺灣梅氏鰟 Taiwan lesser-bream
NCR B2ab(ii)
周銘泰 / 攝

3.4 List of Nationally Endangered freshwater fish taxa in Taiwan (cont.)

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Hemimyzon taitungensis Tzeng & Shen, 1982 **Taitung river loach**	B	A3e+4e	VU	100
Liobagrus formosanus Regan, 1908 **Formosan trooent catfish**	B	B1ab(ii)+2ab(ii)	—	>70
Rhinogobius delicatus Chen & Shao, 1996 **Goby**	B	B2ab(i,ii)	—	>70
Rhinogobius henchuenensis Chen & Shao, 1996 **Goby**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Rhinogobius nantaiensis Aonuma & Chen, 1996 **Goby**	B	B1ab(i)+2ab(i)	—	>70
Oncorhynchus masou formosanus (Jordan & Oshima, 1919) **Formosan landlocked salmon**	B	B1ac(ii,iv) +2ac(ii,iv)[+1]	CR	>70

Rhinogobius delicatus
細斑吻鰕虎 Goby
NEN B2ab(i,ii)
孫文謙 / 攝

Aphyocypris kikuchii
菊池氏細鯽 Taiwan Venus fish
NEN B1ab(i,ii)+2ab(i,ii)
楊正雄 / 攝

3.5 List of Nationally Vulnerable freshwater fish taxa in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Formosania lacustre (Steindachner, 1908) **River loach**	B	B1ab(i,ii)+2ab(i,ii)	—	>70
Hemimyzon formosanus (Boulenger, 1894) **Formosan river loach**	B	B2ab(i,ii)	—	>70
Tachysurus adiposalis (Oshima, 1919) **Bagrid catfish**	B	B1ab(ii)+2ab(ii)	LC	<20?
Distoechodon tumirostris Peters, 1881 **Round-snout nose**	B	B1ab(i,ii)+2ab(i,ii)[+1]	LC	<1
Metzia mesembrinum (Jordan & Evermann, 1902) **Large-scale lesser-bream**	B	C1[+1]	—	<20
Sinibrama macrops (Günther, 1868) **Large-eye Chinese bream**	B	B1ab(ii)+2ab(ii)[+1]	LC	<1
Opsariichthys kaopingensis Chen & Wu, 2009 **Kao-ping freshwater minnow**	B	D2	—	>70
Oryzias latipes (Temminck & Schlegel, 1846) **Japanese rice fish**	B	B1ab(ii)+2ab(ii)[+1]	LC	<1
Channa asiatica (Linnaeus, 1758) **Small snakehead**	B	B2ab(i,ii)[+1]	LC	<1

Metzia mesembrinum
大鱗梅氏鯝 Large-scale lesser-bream
NVU C1[+1]
周銘泰 / 攝

3.6 List of Nationally Near-threatened freshwater fish taxa in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Microphysogobio brevirostris (Günther, 1868) **Short-nose gudgeon**	B	B1b(i,ii)+2b(i,ii)	—	>70
Onychostoma alticorpus (Oshima, 1920) **Taiwan ku fish**	B	B1a+2a	EN	>70
Onychostoma barbatulum (Pellegrin, 1908) **Taiwan shoveljaw carp**	B	A2bc; B1b(i,ii,v)+2b(i,ii,v)	—	<1
Gobiobotia kolleri Banarescu & Nalbant, 1966 **Hainan eight-barbel gudgeon**	B	B1a+2a	—	<5
Rhodeus ocellatus ocellatus (Kner, 1867) **Rosy bitterling**	B	B1b(i,ii)+2b(i,ii)	DD	<1

Aphyocypris amnis
溪流細鯽 Stream minnow
NCR C1
孫華 / 攝

3.6 List of Nationally Near-threatened freshwater fish taxa in Taiwan (cont.)

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Sinogastromyzon nantaiensis Chen, Han & Fang, 2002 **Southern Taiwan Chinese stream loach**	B	B1a+2a	—	>70
Sinogastromyzon puliensis Liang, 1974 **Pulin river loach**	B	B1a+2a	VU	>70
Silurus asotus Linnaeus, 1758 **Amur catfish**	B	B2b(i,ii)	LC	<1
Lentipes armatus Sakai & Nakamura, 1979 **Spiny scale notch-lip goby**	B	B2a	—	<20?
Rhinogobius formosanus Oshima, 1919 **Goby**	B	B1a+ 2a	DD	>70
Macropodus opercularis (Linnaeus, 1758) **Paradisefish**	B	B2ab(i,ii)[+2]	LC	<1

Hemimyzon taitungensis
臺東間爬岩鰍 Taitung river loach
NEN A3e+4e
周銘泰 / 攝

Rhinogobius henchuenensis
恆春吻鰕虎 Goby
NEN B1ab(i,ii)+2ab(i,ii)
孫文謙 / 攝

3.7 The freshwater fish in category of Least Concern in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Mugilogobius myxodermus (Herre, 1935) **Mucus mugilogoby**	B	B2a[+1]	—	<5?
Schismatogobius ampluvinculus Chen, Shao & Fang, 1995 **Goby**	V	B1a+2a[+1]	—	<5?
Schismatogobius roxasi Herre, 1936 **Goby**	V	B1a+2a[+1]	—	<5?
Sicyopus zosterophorus (Bleeker, 1856) **Ornate goby**	B?	B1a+2a[+1]	—	<1
Sicyopterus japonicus (Tanaka, 1909) **Goby**	B	B1b(i,ii)+2b(i,ii)[+1]	—	<1
Stenogobius sp. **Goby**	B	B1a+2a[+1]	—	<1
Channa maculata (Lacepède, 1801) **Blotched snakehead**	B	B2b(ii) [+1]	LC	<1
Anguilla marmorata Quoy & Gaimard, 1824 **Giant mottled eel**	V	—	LC	<1
Acrossocheilus paradoxus (Günther, 1868) **Taiwan torrent carp**	B	—	—	>70
Candidia barbata (Regan, 1908) **Formosan stripe dace**	B	—	—	>70
Carassius auratus auratus (Linnaeus, 1758) **Golden carp**	B	—	LC	—
Chanodichthys erythropterus (Basilewsky 1855) **Predatory carp**	B	—	LC	<1
Cyprinus carpio carpio Linnaeus, 1758 **Common carp**	B	—	VU	—
Hemibarbus labeo (Pallas, 1776) **Barbel steed**	B	—	—	<1

3.7 The freshwater fish in category of Least Concern in Taiwan (cont.)

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Hemiculter leucisculus (Basilewsky, 1855) **Sharpbelly**	B	—	LC	<1
Microphysogobio alticorpus Banarescu & Nalbant, 1968 **Deep-body gudgeon**	B	—	—	>70
Opsariichthys evolans (Jordan & Evermann, 1902) **Formosan pale chub**	B	—	—	<1
Opsariichthys pachycephalus Günther, 1868 **Taiwan freshwater minnow**	B	—	—	>70
Pseudorasbora parva (Temminck & Schlegel, 1846) **Stone moroko**	B	—	LC	<1
Spinibarbus hollandi Oshima, 1919 **Holland's crap**	B	—	DD	<5
Tanakia himantegus (Günther, 1868) **Taiwan bitterling**	B	—	—	<1
Cobitis sinensis Sauvage & Dabry de Thiersant, 1874 **Siberian spiny loach**	B	—	LC	<1
Misgurnus anguillicaudatus (Cantor, 1842) **Pond loach**	B	—	LC	<1
Paramisgurnus dabryanus Dabry de Thiersant, 1872 **Weatherfish**	B	—	—	<1
Tachysurus brevianalis Regan, 1908 **Bagrid catfish**	B	—	—	>70
Monopterus albus (Zuiew, 1793) **Asian swamp eel**	B	—	LC	<1
Rhyacichthys aspro (Valenciennes, 1837) **Loach goby**	B	—	DD	<1

3.7 The freshwater fish in category of Least Concern in Taiwan (cont.)

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Awaous melanocephalus (bleeker, 1849) **Largesnout goby**	B	—	—	<1
Eleotris acanthopoma Bleeker, 1853 **Spinecheek gudgeon**	B	—	LC	<1
Eleotris fusca (Forster, 1801) **Dusky sleeper**	B	—	LC	<1
Glossogobius celebius (Valenciennes, 1837) **Celebes goby**	B	—	DD	<1
Mugilogobius abei (Jordan & Snyder, 1901) **Goby**	B	—	—	—

Stiphodon percnopterygionus
黑鰭枝牙鰕虎 Goby
NLC
孫文謙 / 攝

3.7 The freshwater fish in category of Least Concern in Taiwan (cont.)

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Oligolepis acutipennis (Valenciennes, 1837) **Sharptail goby**	B	—	DD	<1
Redigobius bikolanus (Herre, 1927) **Speckled goby**	B	—	LC	<1
Rhinogobius candidianus (Regan, 1908) **Goby**	B	—	—	>70
Rhinogobius gigas Aonuma & Chen, 1996 **Goby**	B	—	—	>70
Rhinogobius giurinus (Rutter, 1897) **Goby**	B	—	LC	<1
Rhinogobius maculafasciatus Chen & Shao, 1996 **Goby**	B	—	—	>70
Rhinogobius rubromaculatus Lee & Chang, 1996 **Goby**	B	—	—	>70
Sicyopterus lagocephalus (Pallas, 1770) **Red-tailed goby**	B	—	LC	<1
Sicyopterus macrostetholepis (Bleeker, 1853) **Goby**	B	—	—	<1
Stiphodon atropurpureus (Herre, 1927) **Goby**	B	—	—	<1
Stiphodon elegans (Steindachner, 1879) **Goby**	B	—	—	<1
Stiphodon percnopterygionus Watson & Chen, 1998 **Goby**	B	—	DD	<1
Culter alburnus Basilewsky, 1855 **Lookup**	B	B1b(i,ii)+2b(i,ii)[+1]	—	<1

3.8 The freshwater fish in category of Data Deficient in Taiwan

Taxon name	Breeder/ Visitor	Criteria [Category adjusting]	Global Red List Category	Proportion (%) of Global Population
Anguilla bicolor pacifica Schmidt, 1928 **Indian short-finned eel**	V	—	—	—
Anguilla celebesensis Kaup, 1856 **Celebes longfin eel**	V	—	NT	<1
Anguilla luzonensis Watanabe, Aoyama & Tsukamoto, 2009 **Luzon mottled eel**	V	—	NT	<1
Candidia pingtungensis Chen, Wu & Hsu, 2008 **Pingtung stripe dace**	B	—	—	>70
Squalidus argentatus (Sauvage & Dabry de Thiersant, 1874) **Silver gudgeon**	B	—	DD	<5
Squalidus iijimae (Oshima, 1919) **Taiwan gudgeon**	B	—	—	>70
Tanakia chii (Miao, 1934) **Chi's bitterling**	B	—	—	<1?
Hemimyzon sheni Chen & Fang, 2009 **Shen's river loach**	B	—	—	>70
Smilosicyopus leprurus (Sakai &amp Nakamura, 1979) **Caudal-scale smile goby**	B	—	—	<20?
Anabas testudineus (Bloch, 1792) **Climbing perch**	B	—	—	<1

4. Globally Threatened freshwater fish species of Taiwan

Of the 262 candidate species, six taxa were listed as Globally Threatened and Near-threatened by IUCN in 2016 (IUCN 2016), among which three were Nationally Threatened and two were Nationally Near-threatened in Taiwan.

Taxon name	Breeder/ Visitor	National Red List Category	Global Red List Category	Proportion (%) of Global Population
Anguilla japonica Temminck & Schlegel, 1846 **Japanese eel**	V	CR	EN	<20
Oncorhynchus masou formosanus (Jordan & Oshima, 1919) **Formosan landlocked salmon**	B	EN	CR	>70
Onychostoma alticorpus (Oshima, 1920) **Taiwan ku fish**	B	NT	EN	>70
Cyprinus carpio carpio Linnaeus, 1758 **Common carp**	B	LC	VU	<1
Hemimyzon taitungensis Tzeng & Shen, 1982 **Taitung river loach**	B	EN	NT	100
Sinogastromyzon puliensis Liang, 1974 **Pulin river loach**	B	NT	VU	>70

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封底照片 /

1 *Oncorhynchus masou formosanus*
臺灣櫻花鉤吻鮭 Formosan landlocked salmon
NEN B1ac(ii,iv) +2ac(ii,iv)[+1]
楊正雄 / 攝

2 *Hemimyzon taitungensis*
臺東間爬岩鰍 Taitung river loach
NEN A3e+4e
周銘泰 / 攝

3 *Metzia mesembrinum*
大鱗梅氏鯝 Large-scale lesser-bream
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4 *Aphyocypris amnis*
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